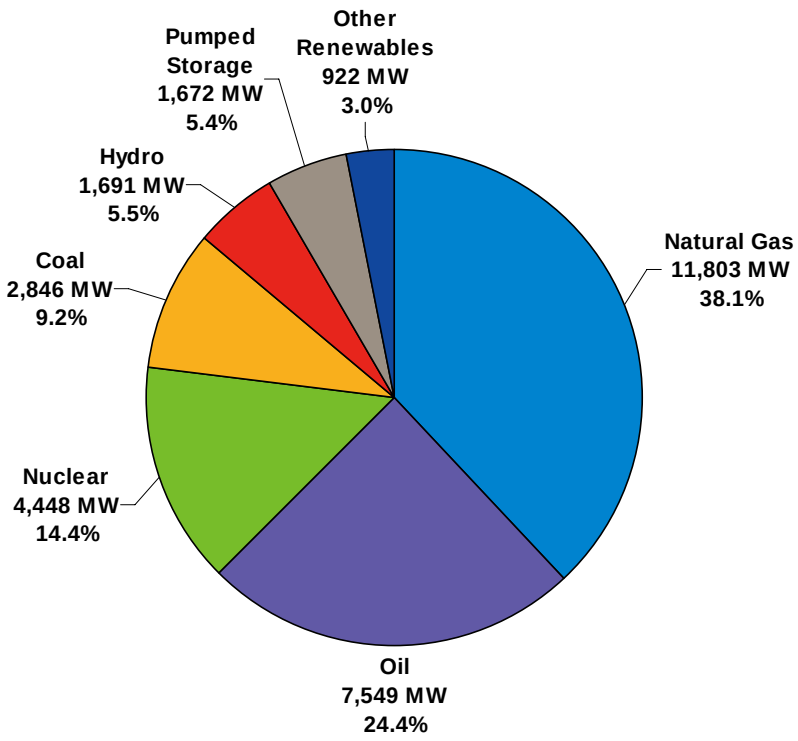
Update on Renewable Portfolio Standards (RPS) and "Clean" Resources

PAC 12
Sturbridge, MA
June 6, 2006

Jim Platts
System Planning

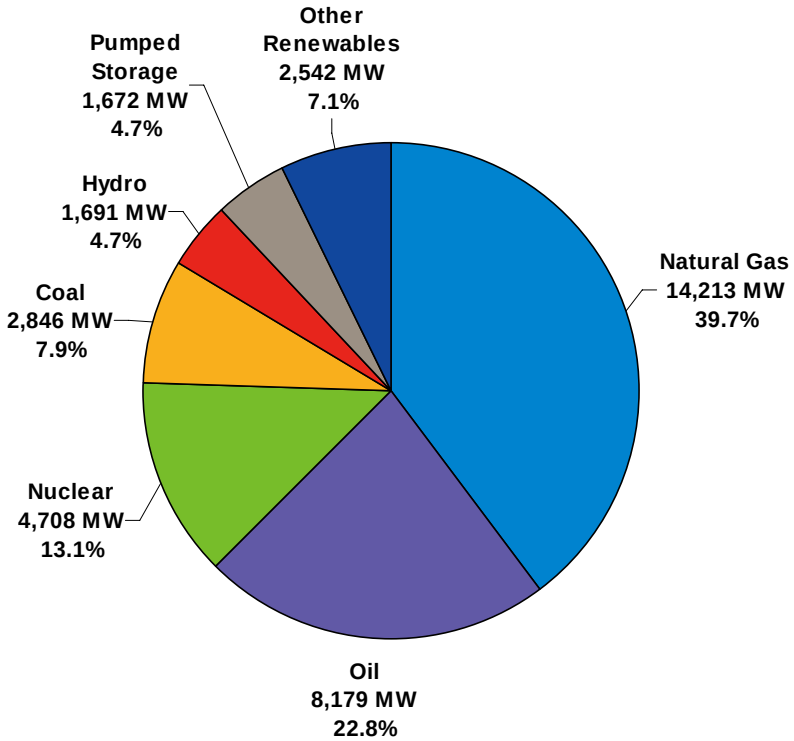
New England Generating Capacity by Primary Fuel Type

Summer 2006



Total: 30,931 MW

With Proposed New Generation

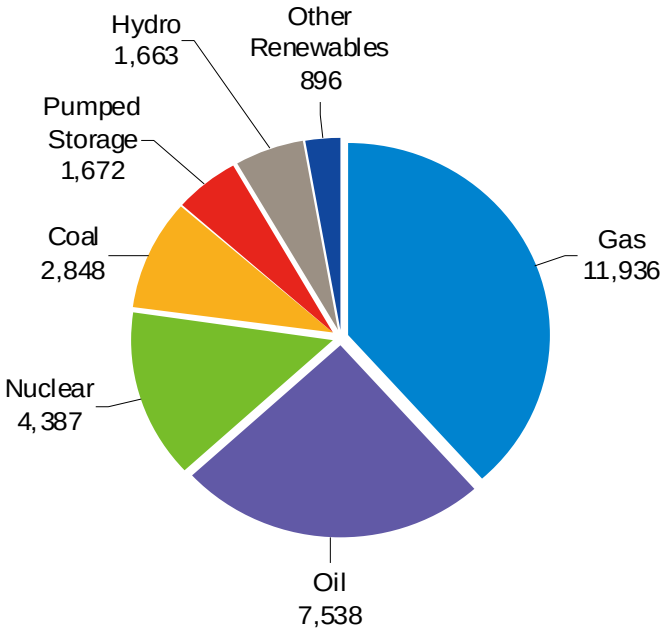


Total: 35,851 MW

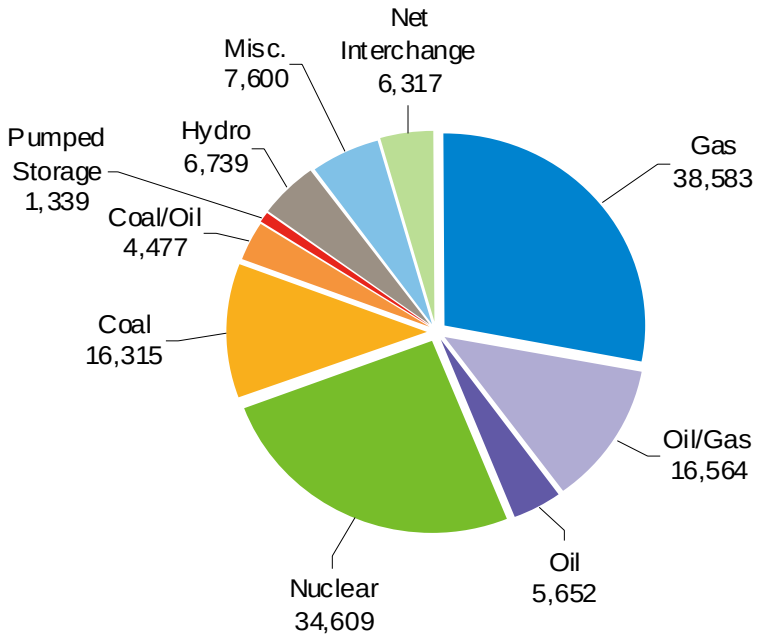
Note: Units in the “Other Renewables” category include those fueled by biomass, refuse, and wind.

2005 Capacity and Energy in New England

Summer Capacity – MW



Energy – GWh



Note: Units in the “Misc.” category include Other Renewables (biomass, landfill gas, refuse, and wind) and Settlement Only Generators.

New England Renewables on the Grid – 2005

Type	Capacity MW	Energy GWH
Hydro	1,663	6,739
Refuse	470	3,766
Wood	389	2,665
Landfill and Bio Gas	58	388
Wind	1	12
Total	2,581	13,570
% of New England Energy	8.4	10

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State RPS Technologies

State	Common Technologies	Special Technologies or Restrictions
Maine	Solar thermal, photovoltaic, ocean thermal, wave, tidal (except RI), wind biomass, fuel cells, hydro (except in MA), landfill gas (except RI)	Allows Municipal Solid Waste (MSW) with recycling, cogeneration, and geothermal
Massachusetts		Biomass with advanced technology and low emissions, fuel cells only with renewable fuels
Connecticut		Hydro < 5 MW, sustainable biomass, MSW
Rhode Island		Fuel cells only with renewable fuels, geothermal

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State RPS Requirements (% of LSE Energy)

	RPS Required Percent		
State	2006	2010	2015
CT (Class I only)	2.0	7.0	7.0
MA	2.5	5.0	10.0
RI	*	4.5	9.5
VT		**	**

*Program does not start until 2007

**VT requires growth in energy 2004-12 be met by renewables

New England RPS Energy Requirements GWh (ISO Projection based on 2006 Forecast)

	GWh		
	2006	2010	2015
CT (Class I only)	660	2,428	2,617
MA	1,322	2,693	5,770
RI	–	405	925
VT	–	225	535
Total RPS Required	1,982	5,752	9,847
2005 CT, MA RPS	1,535	1,535	1,535
New RPS Requirement	447	4,217	8,312
	Total New England		
Projected Energy	135,000	140,330	151,085
Total RPS as %	1.1	4.0	6.5

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Renewable Energy Projects in the ISO Queue

Type (#) of Projects	Size – MW	Assumed Capacity Factor %	GWh
Landfill Gas (1)	15	70	92
Biomass (3)	128	70	785
Wind Onshore (13)	1,011	30	2,657
Wind Offshore (1)	462	38	1,538
Total	1,616		5,072

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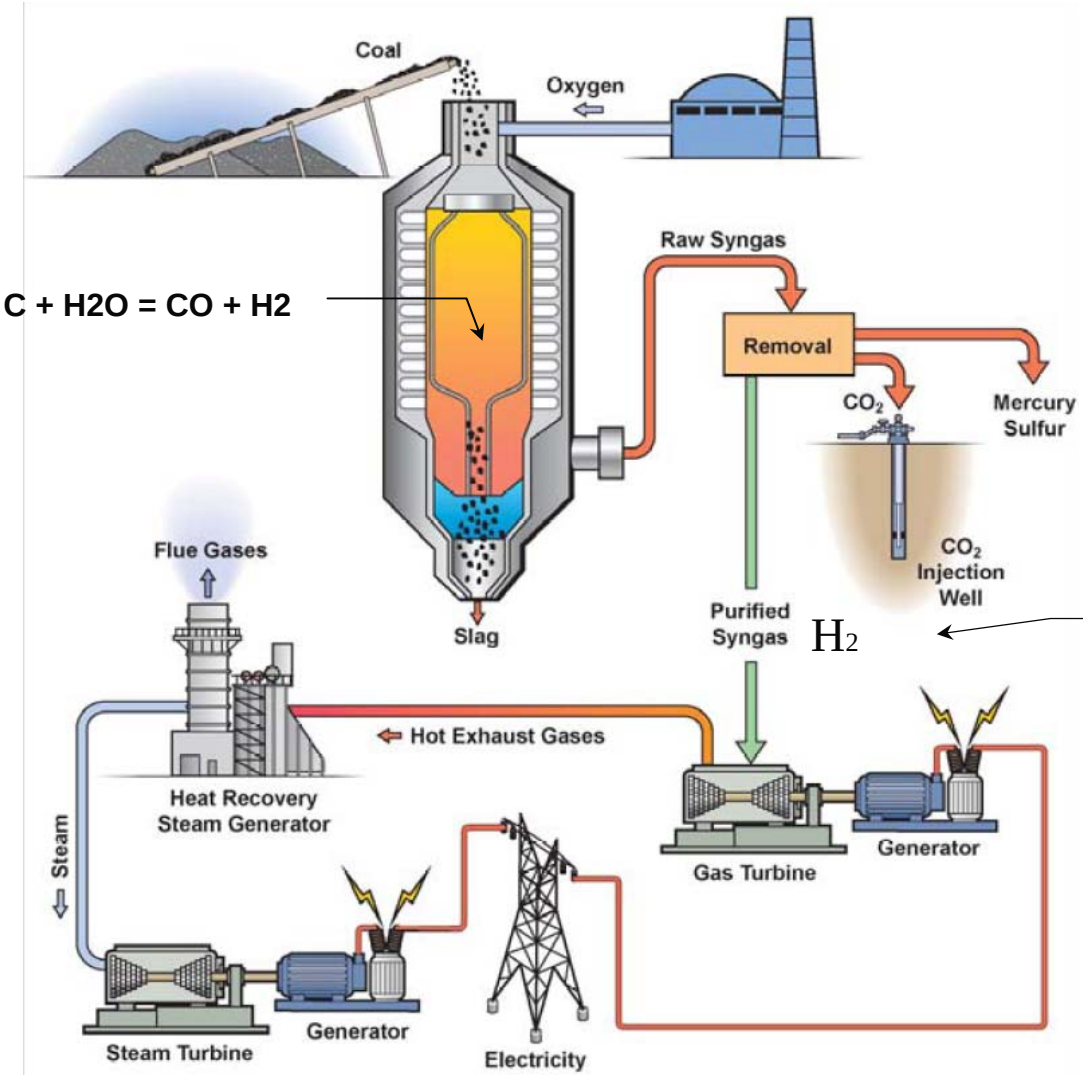
Outlook for Meeting RPS with NE Projects

- By 2010…
  - 18 proposed projects in the queue could meet almost 90% of RPS requirements if all are built
  - 14 of these are wind projects and would provide over 80% of the energy required for RPS
- By 2015…
  - The proposed projects in the Queue would provide just over 50% of RPS requirements if all are built
  - This leaves a big gap for new projects to fill
  - Projects outside the region could help: NY and other states
  - If existing, proposed and new projects meet the required growth in RPS energy, they would provide 6.5% of the region's energy

Clean Energy Resources

Integrated Coal Gasification combined Cycle (IGCC)
Nuclear

What is IGCC?



An IGCC Demo Plant — 262 MW

Wabash, Indiana, Repowered Coal Plant

Repowered Steam Turbine : 104 MW

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Why IGCC?

- Cleanest coal power plant available
- Environmental advantages over a conventional coal plant
  - Low air emissions comparable to natural gas combined cycle
  - 30 to 40 less water usage
  - 60% less solid waste generated
  - 50% lower stack
  - Site footprint may be smaller
- More economic with CO_2 capture
- Construction flexibility:shop fabrication
- Ability to provide multiple products: Electricity, Hydrogen, Steam, CO_2
- But questions remain
  - Not fully proven
  - Load following is difficult
  - Cost disadvantage especially at lower end coals

Three IGCC Vendor Teams

- Major Vendor Teams Using Entrained Flow Gasifiers
  - GE Energy (formerly Texaco gasifier) and Bechtel
  - Shell/Uhde and Black & Veatch
  - ConocoPhillips (E-Gas) and Fluor
- Entrained Flow Advantages
  - Ability to use practically any coal
  - Syngas is free of oils and tars
  - High carbon conversion
  - Low methane production, suitable for synthesis gas products
  - High throughput because of high reaction rates at elevated temperature

Cost Comparison: IGCC vs. NGCC

		NGCC	IGCC
Total Capital Cost ($/kW)		600	1600
Fixed O&M ($/kW-yr)		5.1	56.1
Variable O&M ($/MWh)		2.1	0.9
Average Heat Rate (Btu/kWh)		6800	8600
Capacity Factor (%)		80	80
Fuel Price ($/MMBtu)		7.00	2.25
COE ($/MWh)	Capital Cost (Note 4)	12.8	34.2
	O&M Cost	2.8	8.9
	Fuel Cost	47.6	19.4
	Emission Allowances	2.3	5.0
	Total Cost	65.6	67.5

1. Total Capital Cost of NGCC comes from John Reed study for LICAP FERC Filings; Capital cost for IGCC is from EPRI study
2. Fixed and Variable O&M costs is from EPRI study.
3. Average heat rate comes from various sources
4. Annual Capital Charge rate of 15% is used for both.
5. Emission allowance costs are from ISO's RGGI study

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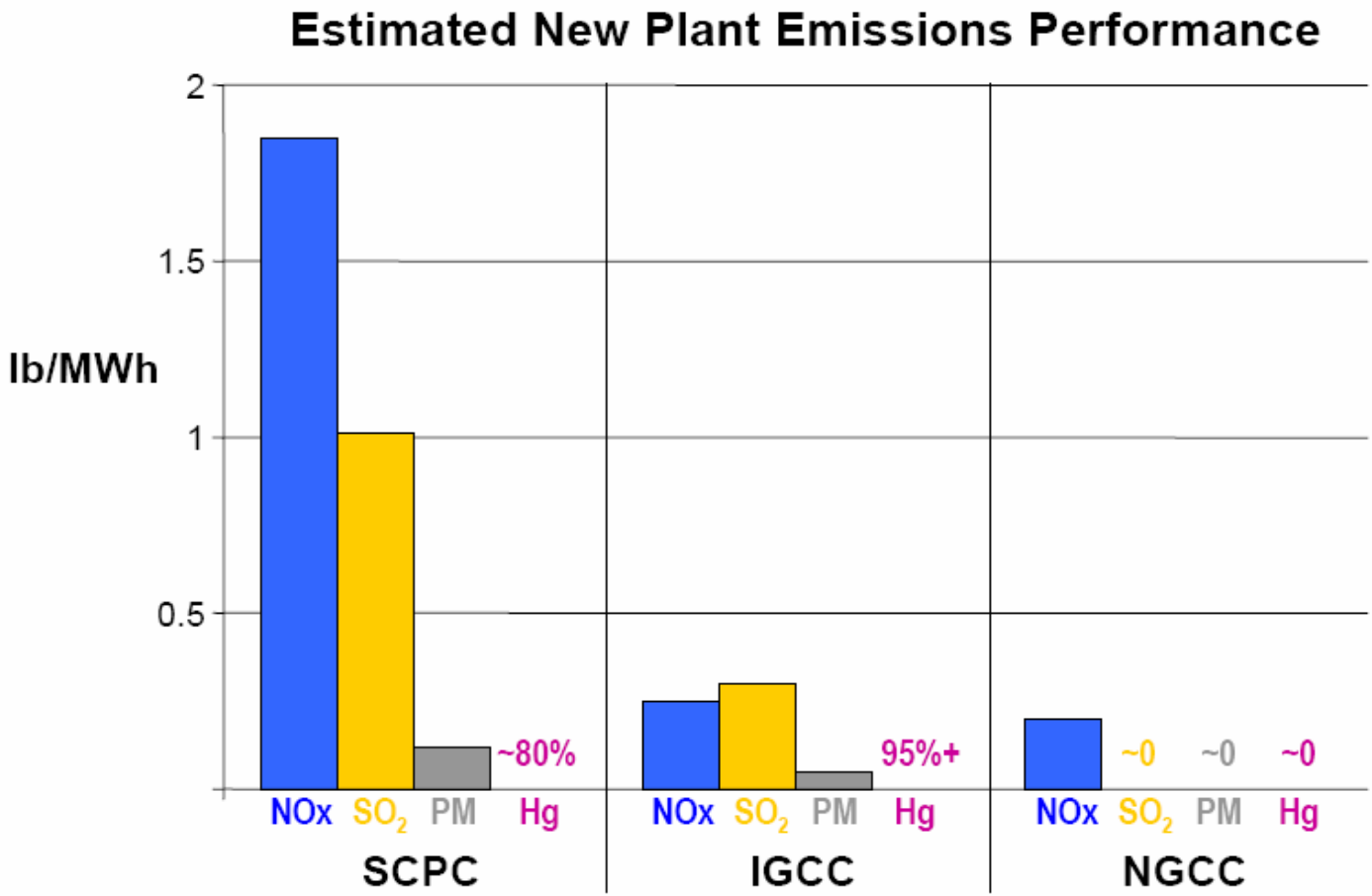
Air Emissions: IGCC, SCPC and NGCC



Gasification as a Strategic Option

Source : William G. Rosenberg, " Gasification as a Strategic Energy and Environmental Option", Harvard University, http://www.usaee.org/pdf/NE_Gasification.pdf

Possibilities for IGCC in New England

- Can existing coal sites be developed with IGCC?
- Could new sites be developed?
  - Coastal
  - River
- Could gasification be deployed at existing NGCC plants to “refuel” them with coal?
- Could a synthetic natural gas plant (e.g.Great Plains Synfuel Plant) be built at the coal mine and 1000 Btu/cf gas injected into the gas pipeline network?
- Implications for improving fuel diversity
- One participant is evaluating IGCC for existing sites

New Nuclear Plant Designs

- Significant progress has been made collaboratively by EPRI, DOE, vendors and the NRC in developing standardized, safer and lower cost designs of nuclear plants
- Several vendor designs have or are being certified by NRC: prior to licensing:
  - Westinghouse BNFL AP1000; and
  - GE, Toshiba, Hitachi ABWR
- NuStart Energy is a consortium of 11 participants:
  - Seeks to demonstrate the feasibility of a combined operating and construction license (COL) for advanced nuclear plant designs;
  - Has selected two sites in Southeastern U.S. for two designs for COL to be followed by engineering and design; and
  - If built, earliest possible operation is 2014-15

New Nuclear Plants in New England

- Region is operating 4 nuclear plants and is accustomed to their benefits:
  - Low operating costs
  - No air emissions
- Existing sites may be possible: Seabrook, Millstone, Pilgrim, Maine and Connecticut Yankee.
- ISO generators Dominion, Exelon, and Entergy are key participants in NuStart Energy.
- A big hurdle -- can nuclear gain public acceptance for siting new plants?
- Stable operating costs, clean air and decarbonizing our energy supply in response to climate change may be the biggest positive drivers for new nuclear plants.

Conclusions

- New England needs more market response with renewable projects to meet the RPS requirements projected for 2015

- The market participants need to consider now the various clean resource options and prepare to implement them to achieve a more robust regional energy mix for the long term

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